

## Q & A from Benefits of Roller Screw Technology in Electric Actuation Webinar

### **What conditions cause heavy contamination?**

It depends on the environment. If a roller screw is packaged, contamination is typically going to be limited to ingress past a worn or damaged shaft seal. Shaft seals are a wear item and their life depends on many variables, including duty cycle, speed and cleanliness of the environment. Consequently, shaft seals are generally field-replaceable. Assuming the shaft seals are intact, there typically isn't going to be contamination on a regular basis other than the screw lubrication migrating to other internal parts of the actuator.

### **Are the screws normally ground or machined?**

For high precision designs, grinding is the normal process for both ball and roller screws. Thread rolling is common for lower cost, lower precision ball screws.

### **What is the maximum linear stroke your design can be adapted for?**

The maximum linear strokes on conventional roller screws are typically based on the machining capability. Roller screws can be manufactured in the 10 to 12 foot long range. Roller screws of this length are typically used for lower speed, very high force applications. For a packaged roller screw, 48 inches is probably going to be a typical maximum length. Packaged electromechanical actuators have gone into the six foot range, so a 72-inch stroke. It depends on the ability of manufacturing technique for the supplier. With regard to the inverted roller screw design, you're again limited by manufacturing technique, but in this case you have to manufacture the inside of a long threaded cylinder. There are different challenges based on length when you are using an external thread versus an internal thread. Typically, you will not see stroke lengths that go much over 18 inches and probably at a maximum of around 24 inches for internally threaded roller screws.

### **What keeps the output shaft from rotating?**

On a conventional roller screw design package, there typically is an anti-rotation groove designed into the housing, and a tab designed into the nut that rides in the housing groove as the actuator extends and retracts. In regards to the inverted roller screw design, part of the installation or the application requirement is going to be having that shaft solidly mounted a

machine coupling or tooling on the machine otherwise providing some sort of external anti-rotation device on that output shaft. There are other ways of using splines and different types of noncircular output shafts that can allow for different types of spline nuts that will provide anti-rotation, but typically you're going to see that mounted on the machine.

### **Can these designs be supplied into all industries – nuclear, petrochemical refineries for example?**

Yes. Most packaged actuators are designed for general-purpose factory automation applications, but can be adapted for use in harsh or unique environments. The challenge, when you start getting into industries like a nuclear industry or certain oil and gas and refinery industries, is obtaining the certifications and ratings required. Is it possible to have packaged electromechanical actuators including roller screw actuators to be certified for those types of environments? The answer would be yes. As far as the Exlar® product line, we have some limited products that are available with some CSA hazardous ATEX/IECEx certifications for different parts of the world regarding hazardous location or explosion-proof type environment. So they are available. It really depends on the products and supplier.

### **How does the back drive force compare against the ball screw?**

The theoretical back drive force is going to be based on the lead of the screw, its efficiency and the amount of force being pushed against the screw. Typically with a ball screws are offered with a higher lead, and that higher lead is going to back drive a little bit easier. With a finer lead, just from physics you're going to have a harder time to push that back. Comparing a ball screw to a roller screw with the same lead, the back drive force is going to be very similar depending on the efficiency.

### **What is the maintenance schedule life for a typical roller screw?**

The maintenance schedule for any geared mechanical device, whether ball screw, roller screw, or gearhead, is going to be based on the amount of heat that is generated in the application, the amount of degradation of the grease, the type of grease being used, and the duty cycle. We provide some guidelines for our customers as starting points, but we recommend that for all new

installations the lubrication be periodically inspected for presence and degradation as the best method for determining the right maintenance schedule for a given application. Having said that, we've seen repairs of units that have been in use for 15 years and when we've asked about grease renewal, they didn't even realize that the unit could be serviced in the field. So we've had situations like that where they've gone for long periods of time with effectively no maintenance or no grease renewal. There are other applications that require grease renewal in very short intervals just due to the nature of the application.

### **Can you please provide a cost comparison between a ball screw and a roller screw actuator?**

Cost comparison of a roller screw to a ball screw is really a difficult subject, mainly because we have to take into account the pieces that we're comparing. So if we're taking an application and comparing one application to another application, a roller screw is typically going to be competitive to a ball screw in regards to price because we can oftentimes use a roller screw that is a smaller size and typically you're going to see pricing go up from smaller sizes to larger sizes. So if you're using a smaller frame size roller screw and comparing that to a larger size ball screw, your pricing is potentially going to be very similar. Now depending on what the customer's needs are, if they're looking for something with much greater life, we're not necessarily comparing an equal product. So we look at that extended life, you may have to buy two ball screws in comparison to one roller screw. So if you look at that from a value standpoint, you may pay more for a similar frame size roller screw but you may have to buy two ball screws in the same period of time that you'd have to buy that one roller screw.

### **How does a roller screw compare to a hydraulic actuator of equal size and rate force?**

That is going to depend on the application, but frequently we can create a package that will be similar in size and in force characteristics to a comparable hydraulic cylinder. Hydraulics are always going to have their place in the market once you get beyond 100,000 lbs. of force. But typically a roller screw actuator will be slightly larger, but close in size, compared with a standard hydraulic cylinder.

### **This is a question regarding premature wear. If an actuator movement is repeatedly used in one spot, will this bring on premature wear?**

I wouldn't say its premature wear. In the case of an actuator that's run in a single spot, you're effectively using a singular process. When you're using a pressing application, you're going to end up hitting the same spot over and over and over again, so in turn your theoretical life calculation tends to be less the number of inches you can travel and more the number of times you can cycle to that same point over and over and over again. So that again plays a role in the life. We typically do have some derating factors that we use in order to provide our customers with an idea of what the best life they are going to get in pressing or a very short stroke type application.

### **Can roller screws go up to 50,000 or 60,000 pounds of linear motion?**

Yes, Exlar produces conventional roller screw actuators from 5,000 pounds all the way up to 40,000 pounds. In some cases, we have done some special designs for customers that go up to 60,000 and maybe even 100,000 pounds in certain applications. So the technology is capable; it's really a matter of what the manufacturer is able to do regarding packaging matters.

### **What are the maximal operating temperature limits for a roller screw?**

The maximum operating temperature limits for a roller screw are going to be based on the ability for the grease to handle that temperature, so unless you're getting to the melting point of the raw material, you're probably not going to have much trouble. It's really going to be based on how long the grease will last within that environment. When we shift over to an integrated package design like the inverted roller screw package that we showed, there you're going to have the permanent magnet motor thermal limitations, so in the case of most brushless motors, you're going to have somewhere around 100° C case, 130° maybe even up to 150° C temperature range for a servo motor or a brushless permanent magnet motor. We typically recommend a maximum of 85° C in an ambient environment, potentially higher than that in certain applications. It starts to become very application-dependent once you get above 85° C in the ambient environment.

### **Are there any restrictions in the orientation of operation, horizontal versus vertical, for a roller screw?**

There really aren't. It becomes more a measure of what the force requirements are for the given orientation and how the load is supported. If you're looking at a horizontal orientation that's sliding along rails, you may have a higher inertia if you have a big, big load sitting on those rails, whereas if it's a vertical application where you're lifting and lowering a lot of tooling, you're going to take into account that tooling weight. So really the orientation has no effect on the screw itself, but it could have considerations that are needed when you're choosing the screw to make sure that you get the right screw for the application or package actuator.

### **Are roller screws multi-lead?**

I think what they're talking about there is multiple starts in the screw. So roller screws are going to have multiple start threads. Depending on the diameter, you could have three, four, six starts of thread in any given diameter, so the manufacturing techniques allow for making those multiple thread starts within the screw.

**Can roller screws be used in applications where high linear stroke speeds are required, for example a 24 inches per second moving a 1 ton load?**

Yes, that would be a common application. In the integrated package design, you might see speeds that could get up to 40 inches per second. You might see forces that go up to 10,000-12,000 pounds. Now if you're going 40 inches per second, we're probably not going to be doing 12,000 pounds. We're probably going to be doing more like 4000-5000 pounds at a maximum. But if you're doing 12,000 pounds you might see a max speed of 5 inches per second. And then once you go to the conventional roller screw design where you're adding back that external motor, then you really have a lot more flexibility on power range. You can get a really, really big motor if necessary. Depending on all the application characteristics, you can get a screw going pretty fast while also having a fairly high force, potentially upwards of 10,000 pounds or even 20,000 pounds of force. If you have a large enough motor, you could be going 20 or 30 or 40 inches per second.

**When you calculate the screw life, how is lubrication considered?**

The lubrication actually isn't considered in screw life, and that's mainly because we consider that a separate discussion. We separate maintenance from life. Life is assuming a consistent good lubrication over a period of time. The L10 life is typically what we offer, which is 90% of the time you're going to get this life out of the screw. If a screw is not maintained at all over a period of time, is it possible it could last through its entire life? I would say yes, it's possible. It's probably unlikely in a lot of cases, but in certain cases you could have a situation where the screw would go through its expected life and meet the customer's requirements without having grease renewal.

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